AMENDMENT

Please enter the following amendments.

IN THE SPECIFICATION

At page 7, after line 19 and before line 20, please insert the following paragraph:

The patent or application file contains at least one drawing executed in color. Copies of this patent with color drawings will be provided by the Office upon request and payment of the necessary fee.

Replace the paragraph beginning at page 27, line 28 with the following rewritten paragraph:

A preferred embodiment of a steam reformer system is illustrated in **Figs. 10-15.** This system is called "the Compact Microchannnel Steam Reforming Unit" in the following discussion. A schematic overall view of the apparatus **101** is illustrated in color in **Fig. 10** (a black and white rendition is included as **Fig. 18**). Fresh air enters through air preheater inlet **106** and is warmed in the air preheater (gray block). The air is split into four streams moving through conduits **110** (green) to four recuperators **124, 140** (pink). Each of these recuperators contains a recuperative heat exchanger **120** and water vaporizer **122**. Hot air exits recuperator **120** into header **112** (gray) and is mixed with fuel in tube **102** (red) which travels to combustor **104** (red). The resulting combustants travel through header **118** to reactor **114** (blue). The gas runs in series through four cells. In each cell, heat from the combustants is transferred to drive the endothermic production of hydrogen. At the reactor, the combustant stream is connected in series while the reactant stream is connected in parallel. After passing through the first cell, the gas leaves the reactor **114** through header **116** (purple) and hydrogen gas is injected through an inlet (not shown) in the header **116**. The hydrogen gas spontaneously ignites, adding heat to return the gas to the temperature at which the gas first entered the reactor. The gas then reenters the reactor to

again drive the formation of hydrogen. After passing through the fourth cell, the combustant gases exits through a header <u>**134 (pink)**</u> ~~(orange)~~ where it is split into four separate streams and used to vaporize water. The combustant streams are recombined in header **108** and used to warm up air in the air preheater before being exhausted.

Replace the paragraph beginning at page 28, line 17 with the following rewritten paragraph:

In the other fluid stream, water (which optionally could come through a preheater) comes into each of four water vaporizers **122,** is converted to steam, and passes through headers **126** (blue) to fuel vaporizer **132** (yellow) where the steam is mixed with fuel from a fuel inlet (not shown) and each of the four mixtures passes through a header <u>**138**</u> (yellow) into a cell of reactor **114** where hydrogen is produced. In a preferred embodiment, both the reformate stream and the combustant (heat exchange) fluid streams exit the reactor at about 750C. Heat from the reformate stream is recovered in recuperator **130** and vaporizer **132** and the reformate exits the device (through gray tubes).

Replace the paragraph beginning at page 28, line 25 with the following rewritten paragraph:

The design for the air preheater was an interleaved microchannel heat exchanger <u>1000</u> that consisted of 10 pairs of shims consisting of 20 mil (0.50 mm) shims partially etched to a depth of 10 mil (0.25 mm). The entire device was constructed of 316L stainless steel. The shim design for shim "A" is shown in **Fig. 12a**. The "B" shim, shown in **Fig. 12b**, is the same as the "A" shim except that it connects to the alternate set of header holes. The device is covered top and bottom by 50-mil (1.25 mm) thick cover plates. The shims are assembled: Top Plate, A, B, A, B...A, B, Bottom Plate. The top plate has 20 header holes that align with the header holes 1010, 1020 in Plate A and the bottom plate has 20 header holes that connect to the header holes in Plate B. The two gases flow countercurrent in the heat exchange section and in the headers (e.g. the initially hot gas enters through headers 1010 and leaves through headers 1020 while the initially cold gas enters through headers 1030 and leaves through headers 1040). The shims were

7.1 inch long and 3.0 inch wide. The heat exchanger was bonded as described above.

Replace the paragraph beginning at page 29, line 13 with the following rewritten paragraph:

The shim design for a combined recuperative heat exchanger **130** and fuel vaporizer **132** is illustrated in **Figs. 11a and 11b**. These shims were 17 mil thick with an etch depth of 6 or 7 mil. Each shim is 1.5 inch wide (excluding assembly alignment holes **152**, which are cut off after bonding) and 5.34 inches long. The shims shown in **Figs. 11a and 11b** were stacked in alternating layers capped by end plates having inlet and outlet fluid headers. The flow microchannels were structurally supported by 10 mil thick lands. In the heat exchanger layer, hot reformate gas enters through inlets **162**, and travels through the layer to outlet **150**. While fluid flow flows within a single microchannel, that fluid participates in three unit operations. In the illustrated embodiment, in region **158** heat is transferred to reactants prior to entering the reactor, in region **156** heat is transferred to fuel vaporizer **176**, and in region **154**<u>, **172**</u> heat is transferred to water. The heated water exits through outlet **170**. Vaporized fuel exits through outlets **174**. Reactants enter through inlets **178** and exits through outlets **160**. Preferably there are at least two layers with a fuel vaporizer and at least one heat exchanger layer, more preferably there are at least three layers with a fuel vaporizer and at least two heat exchanger layers. Each of the layers preferably has a thickness of between 0.1 and 1 mm. While the description refers to a steam reforming process, it should be recognized that the inventive concepts apply to a wide variety of reactions and unit process operations.

Replace the paragraph beginning at page 30, line 26 with the following rewritten paragraph:

The shim construction for the reactor **114** is shown in **Figs. 15a-e**. The reactor contained 75 reaction chamber layers alternating with 76 heat exchanger layers. Each reaction chamber layer consisted of a pair of mirror-image reaction chamber shims **300** separated by a spacer shim **340**. The spacer shim had a 12 mil thickness. Each heat exchanger layer consisted of a pair of mirror-image heat exchanger shims **350**. Cover plates **312** were welded on to create reactant

channel **302**. Reaction chamber **314** was formed by etching 5 mils into the shim while leaving a series of struts **322** and **324**. The reaction chamber **300** and heat exchanger **350** shims were 20 mils thick. Each of the four identical reaction chambers was about 2 inches by 2 inches. The narrower, 5 mil struts **322** support catalyst strips while the thicker struts **324** align with wires **342** to provide structural supports. The wires **342** had a thickess of 12 mil and a width of 10 mil. The "X"s in Fig. 15c indicate empty spaces. These spaces are occupied by strips of catalyst felts (2.1 inch long x 0.25 inch wide and 10-12 mil thick). Preferred catalyst materials are described in U.S. ~~Patent applications, serial nos. 09/492,950 and 09/492,246 (Atty docket no. E-1666A-CIP and E-1666B-CIP)~~ Patents Nos. 6,440,895 and 6,616,909 incorporated herein by reference. The heat exchanger shims contained combustion gas inlets **354** and combustion gas outlets **352,** and four sets of flow microchannels **356**. The endblocks are usually thicker than the individual shims, typically 0.25 to 0.35 inch thick. One end block is a featureless metal sheet. The other end block **360** is illustrated in **Fig. 15e**.